Single Photon Simulations

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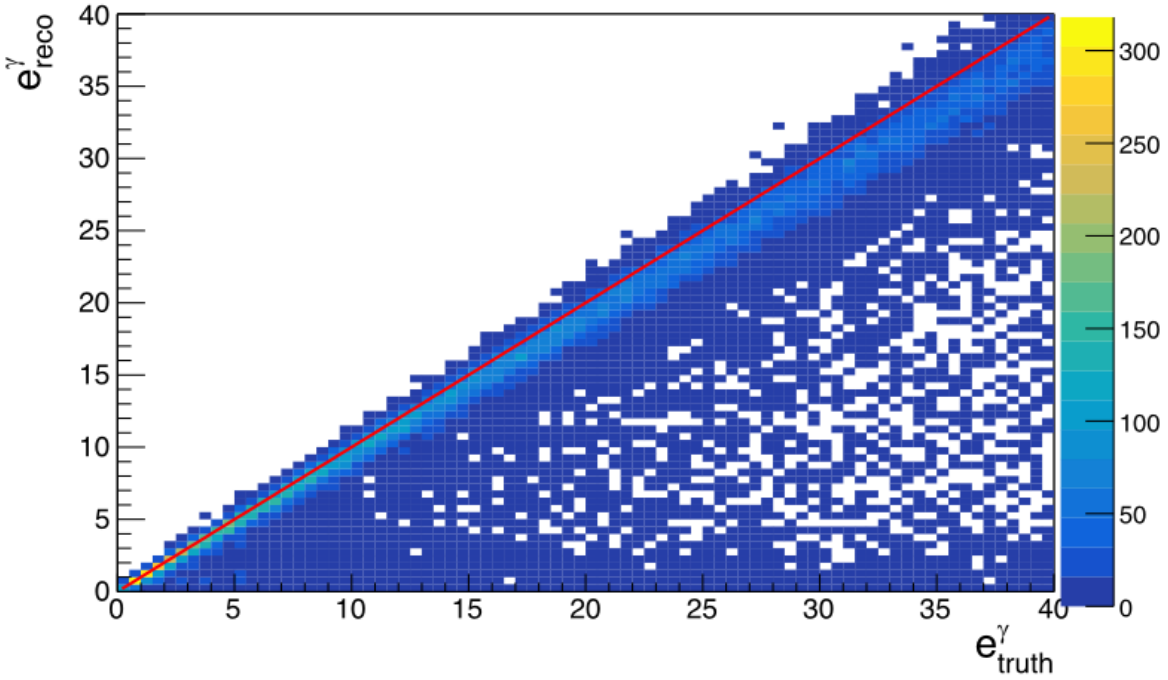
Overview

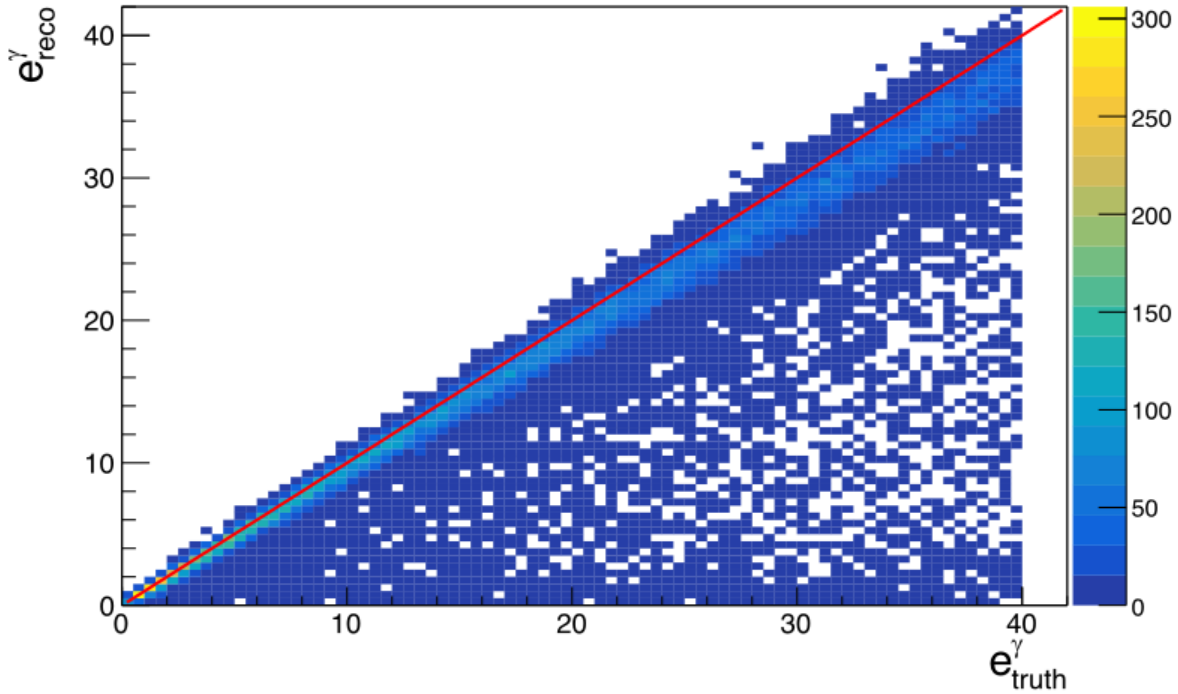
- Last presentation: March 7
- Showed some first look at single photon gun simulations
- Today:
  - Switched to 2D SPACAL for photon reconstruction
  - More investigation of low energy cluster garbage

Energy Response

Without angular cut



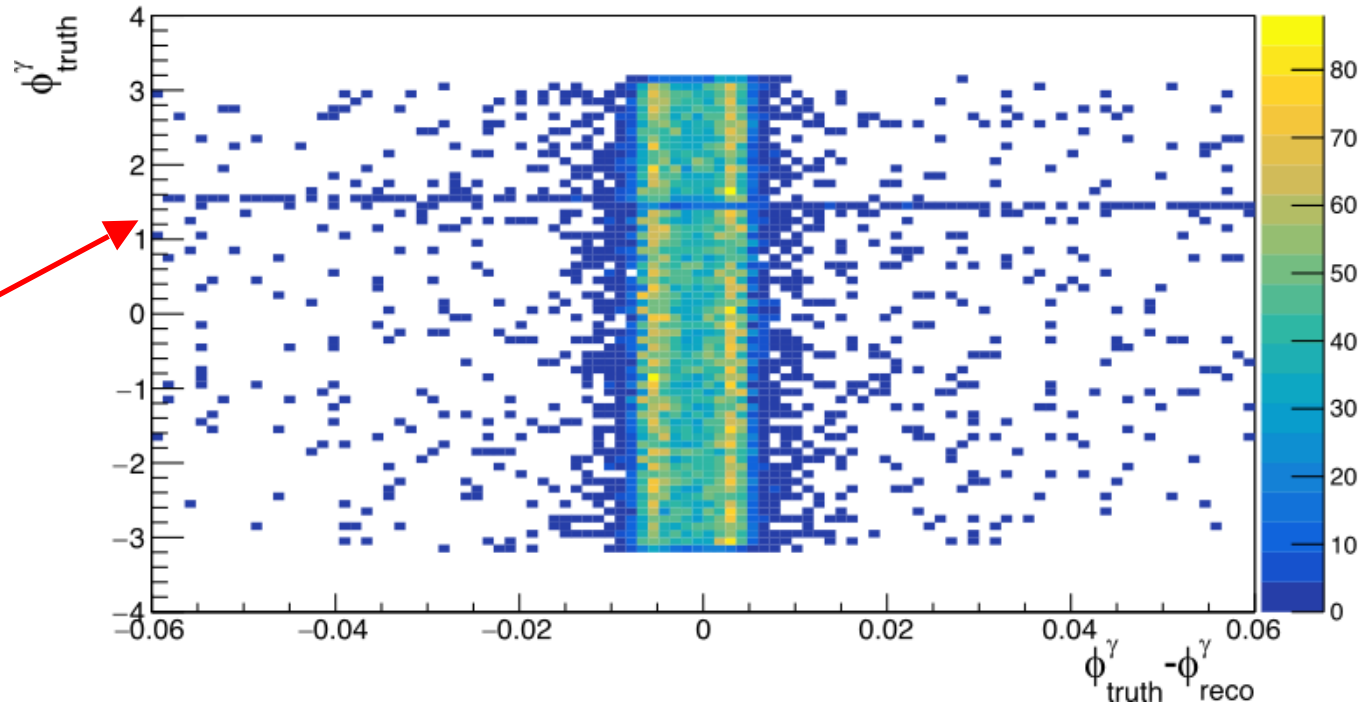
With angular cut Δϕ<0.02 && Δη<0.02



- Angular cut doesn't clean up low energy mismatches
- Private discussions with Frantz group confirms they see similar results

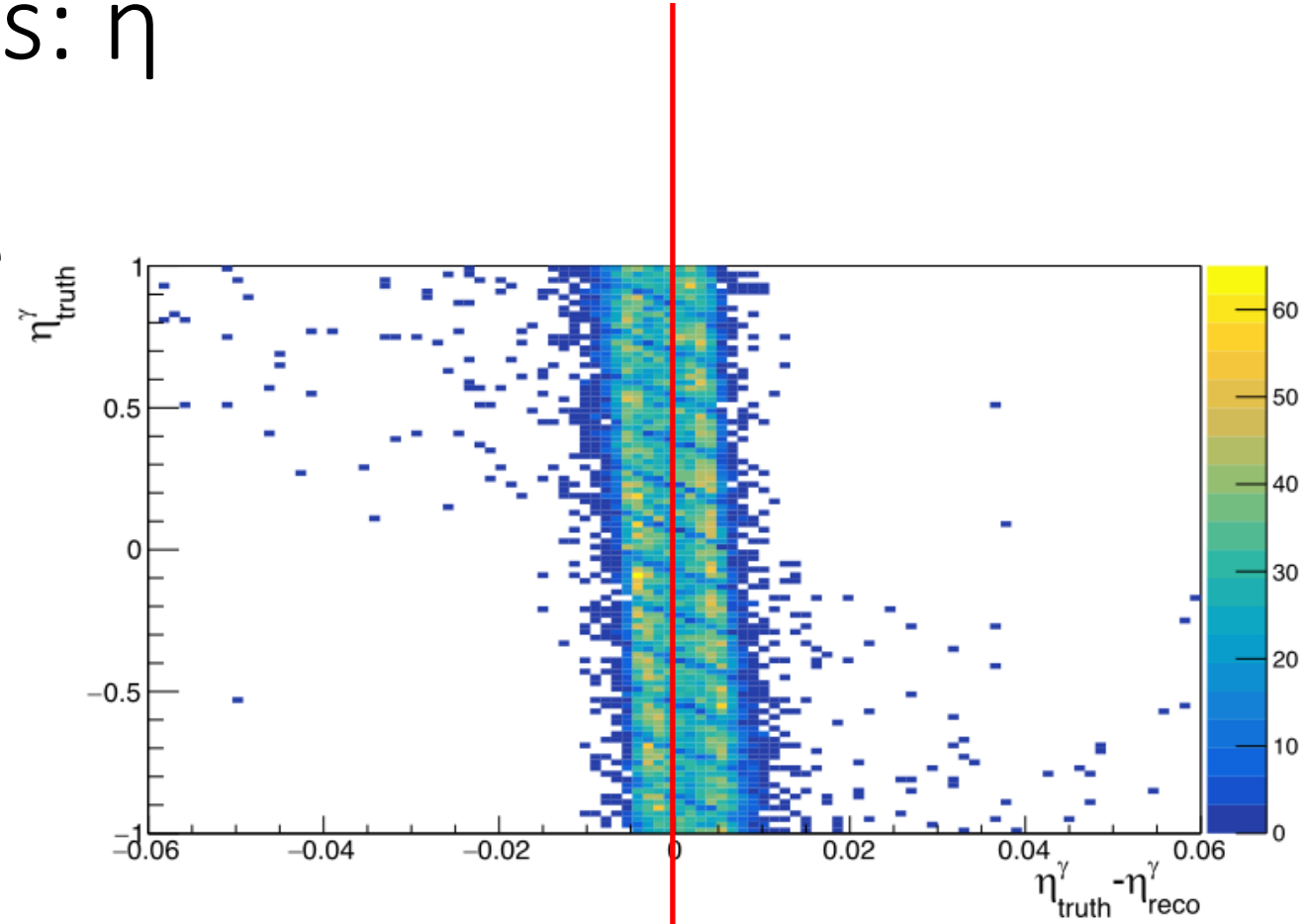
2D Angular Histograms: ϕ

- Reminder: ϕ shows bimodal structure
- Bimodal behavior basically the same across all ϕ
- What is this feature…?



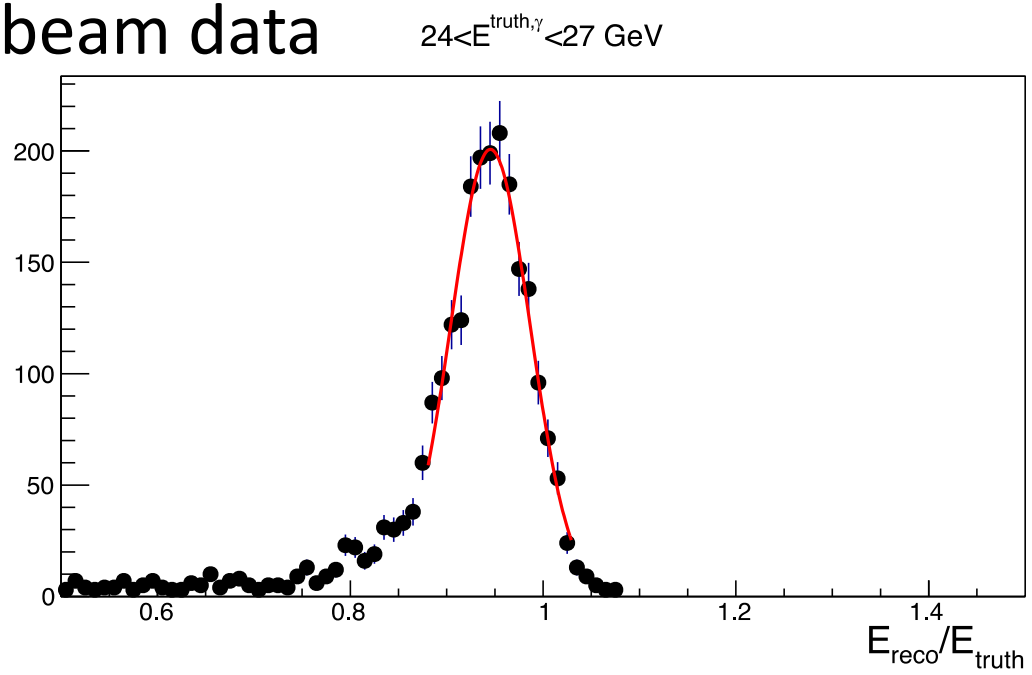
2D Angular Histograms: η

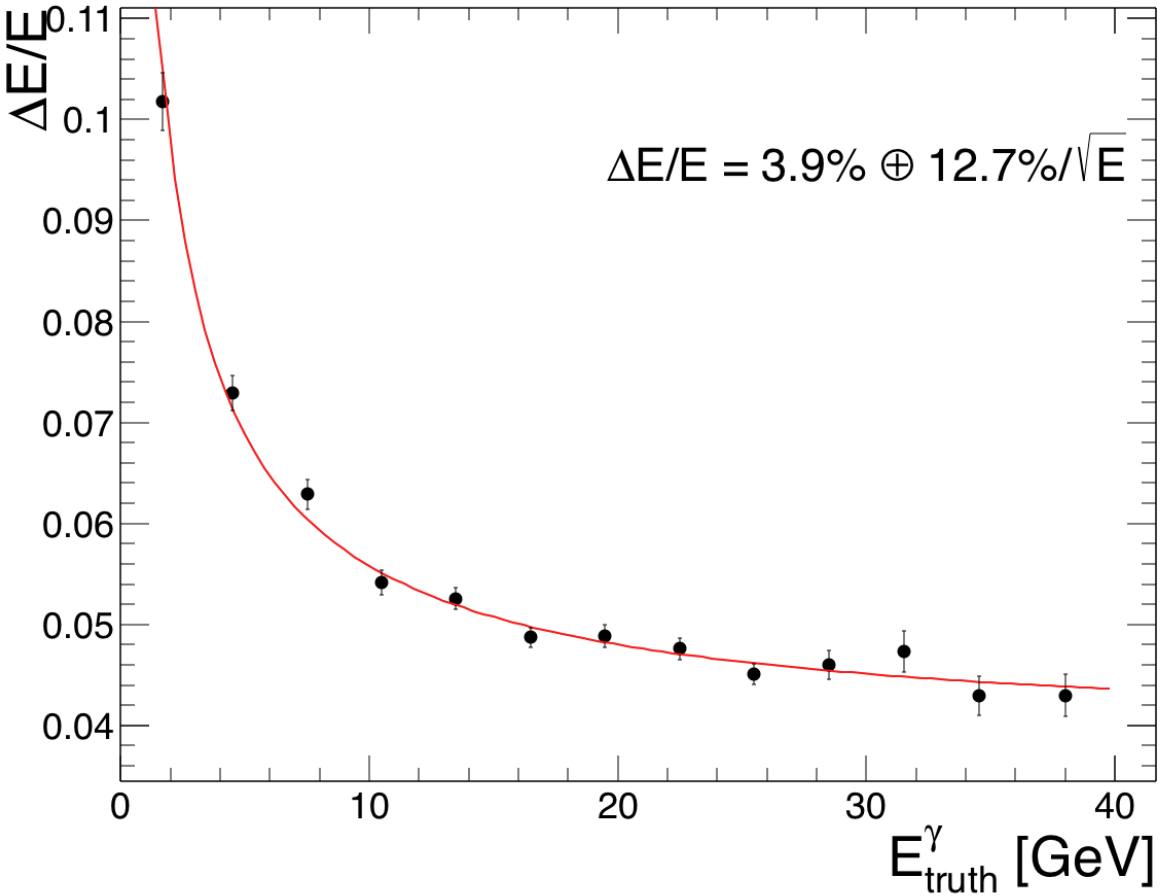
- η shows some bimodal structure as well
- Additionally asymmetric about 0
  - From EMCal module tilting?
- Seems that the module boundaries are visible?



EMCal Resolution in Simulation

- Fit energy responses to Gaussians (example below)
- Extract width, plot as a function of E_{truth}
- Constant term looks resonable, sqrt(E) term looks a bit small compared to test beam data

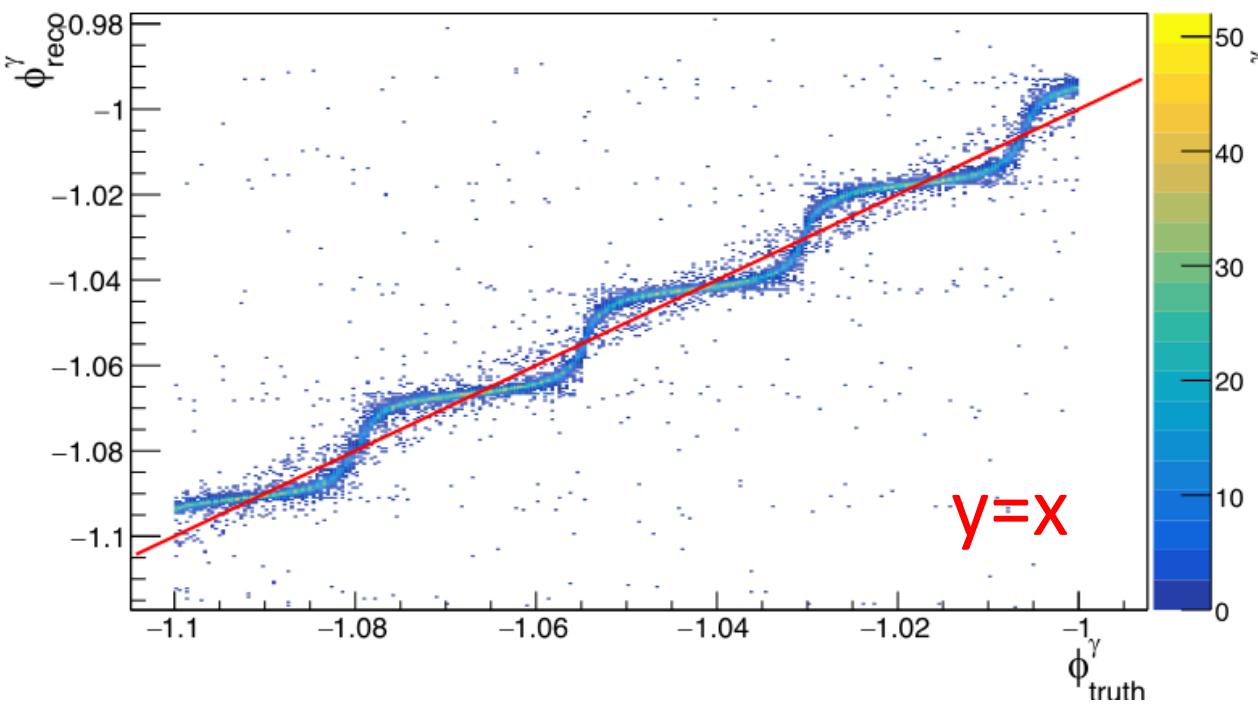


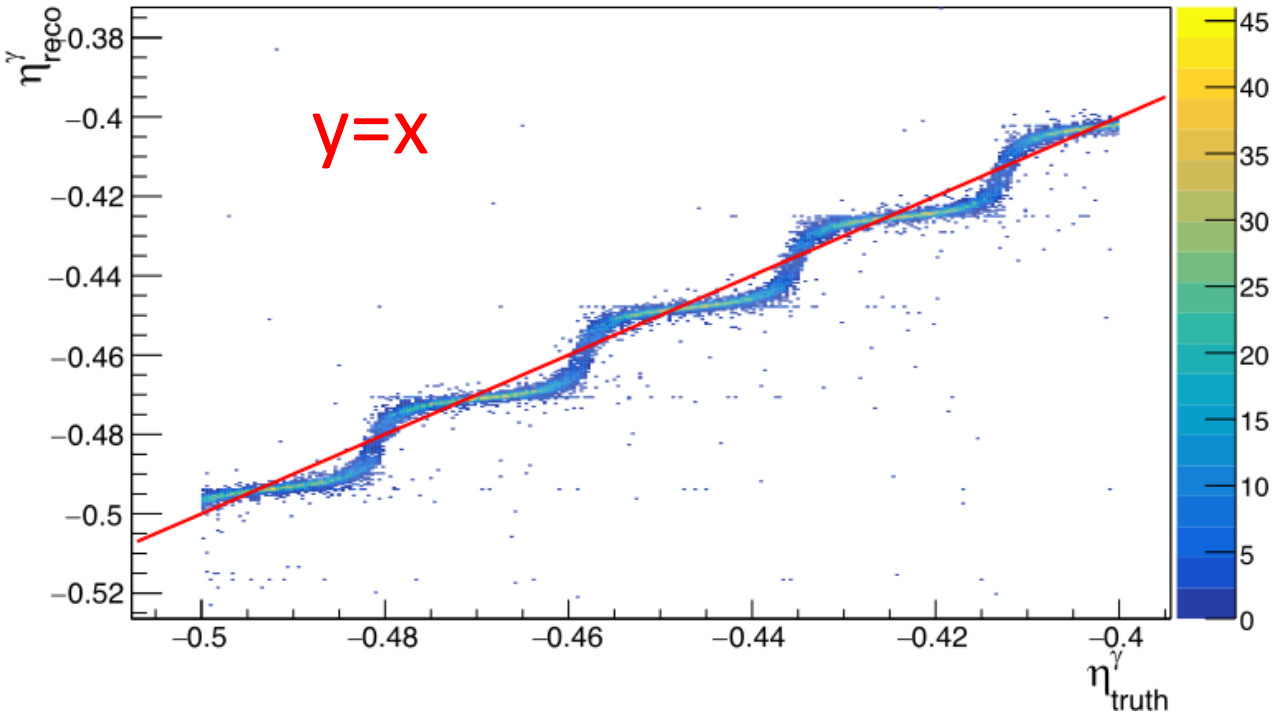


Small Phase Space Photons

- I threw photons in a much smaller phase space to try and observe the nonlinearity effect Jin referred to last week
- Threw in $-0.5<\eta<-0.4$, $-1.1<\phi<-1$
- This is an area of the detector that the previous plots showed is pretty normal/uniform
- Look for nonlinearity in $\Delta\phi$ and $\Delta\eta$

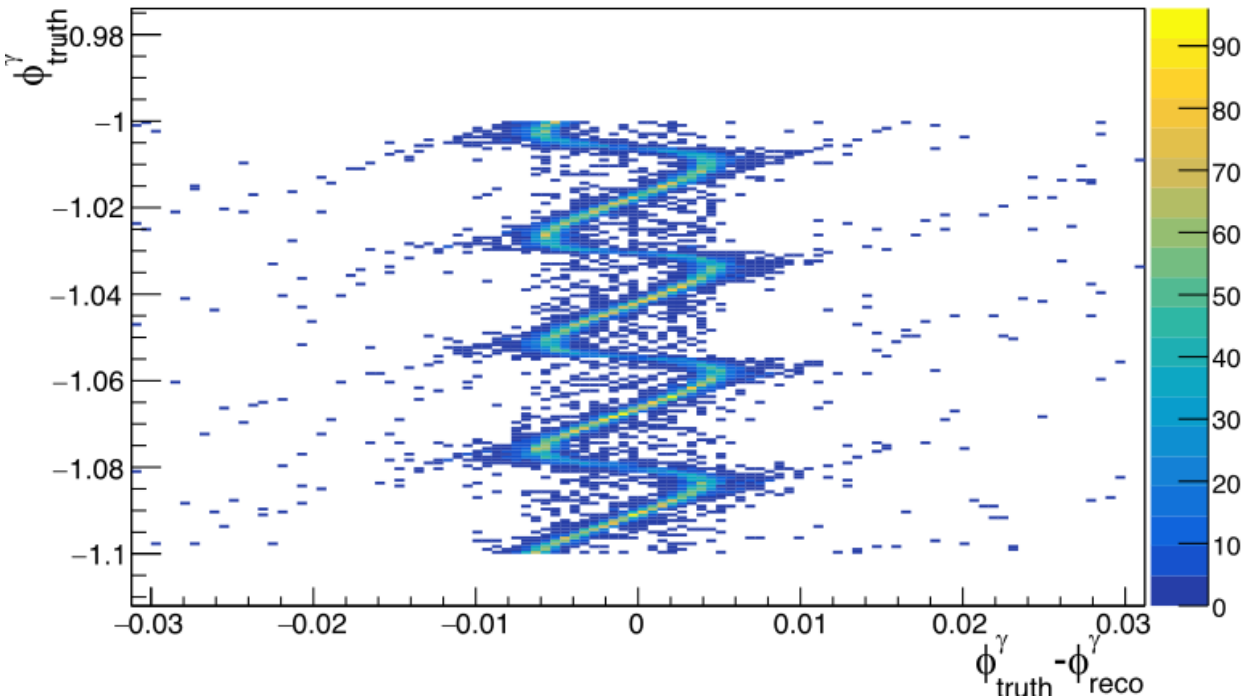
Angular Response Fine Binning

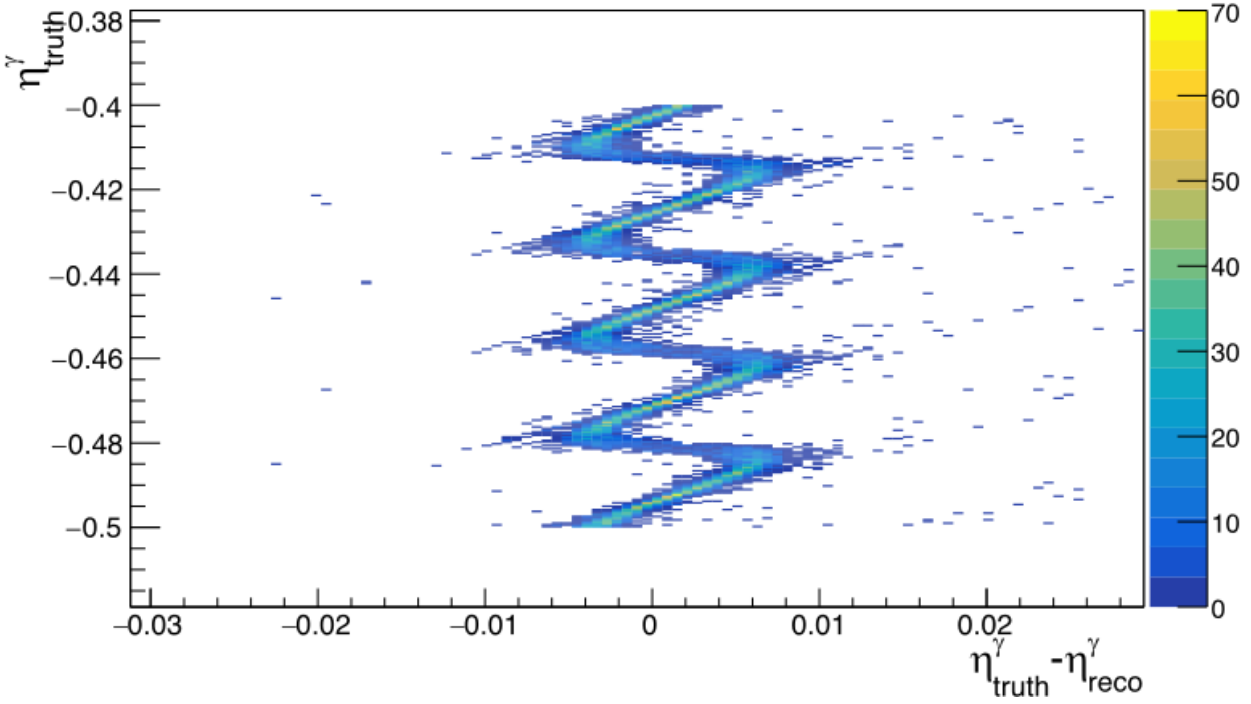




Clear nonlinearity in both ϕ,η

Δϕ,Δη Response Shows Nonlinearity



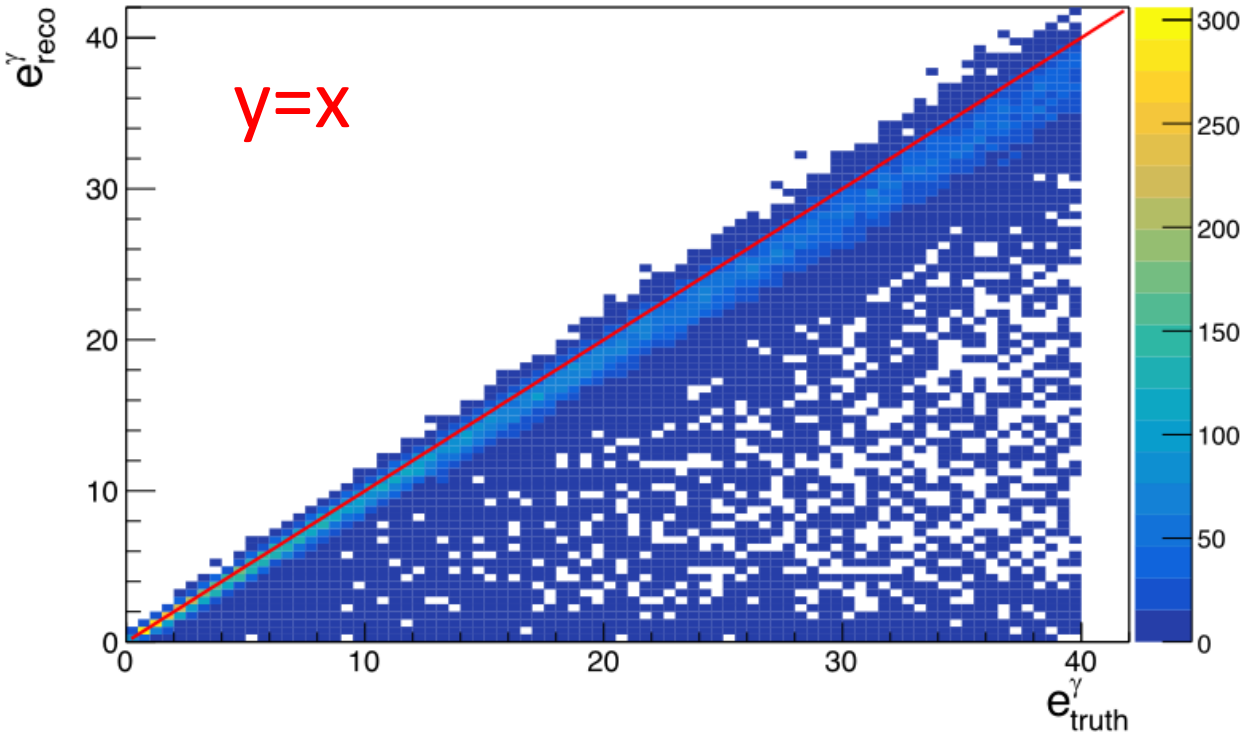


- Nonlinearity shows same structure in η,ϕ and Δη, Δϕ
- Note that this behavior is the same for $e_{reco}/e_{truth}<0.7$ and $e_{reco}/e_{truth}>0.7$

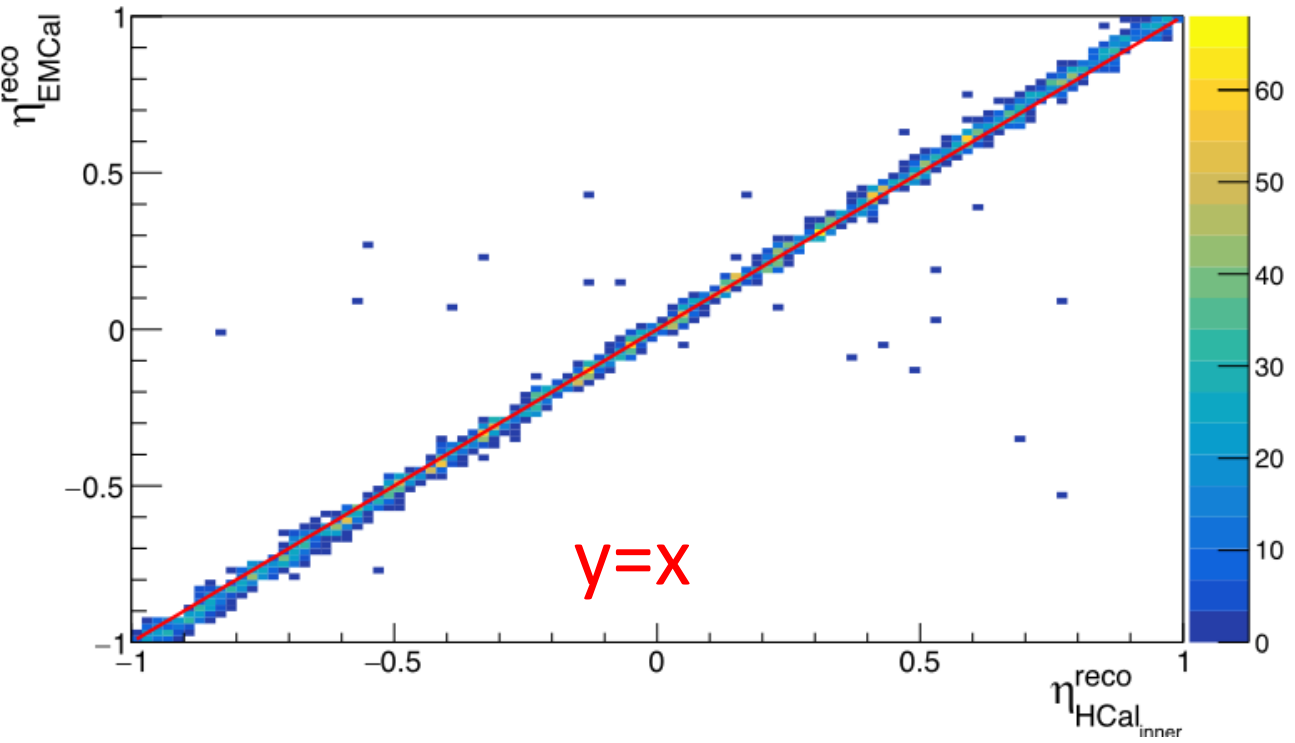
Inner HCal + EMCal Correlations

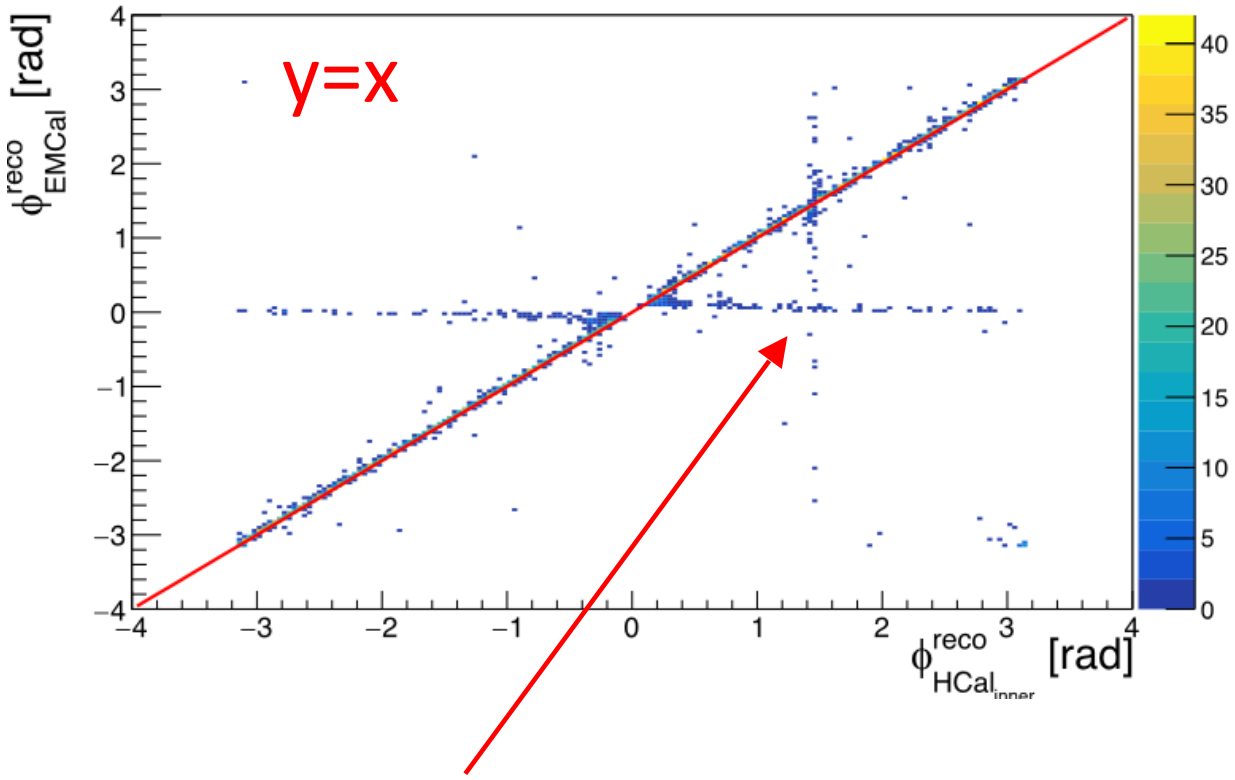
HCal Correlations

- Jin suggested looking at possible correlations with inner HCal
- Is there any tunneling going on through EMCal block boundaries?
- If so energy would be deposited in HCal behind EMCal
- This might indicate why there are so many low energy clusters in the EMCal



Angular Correlations Between HCal/EMCal



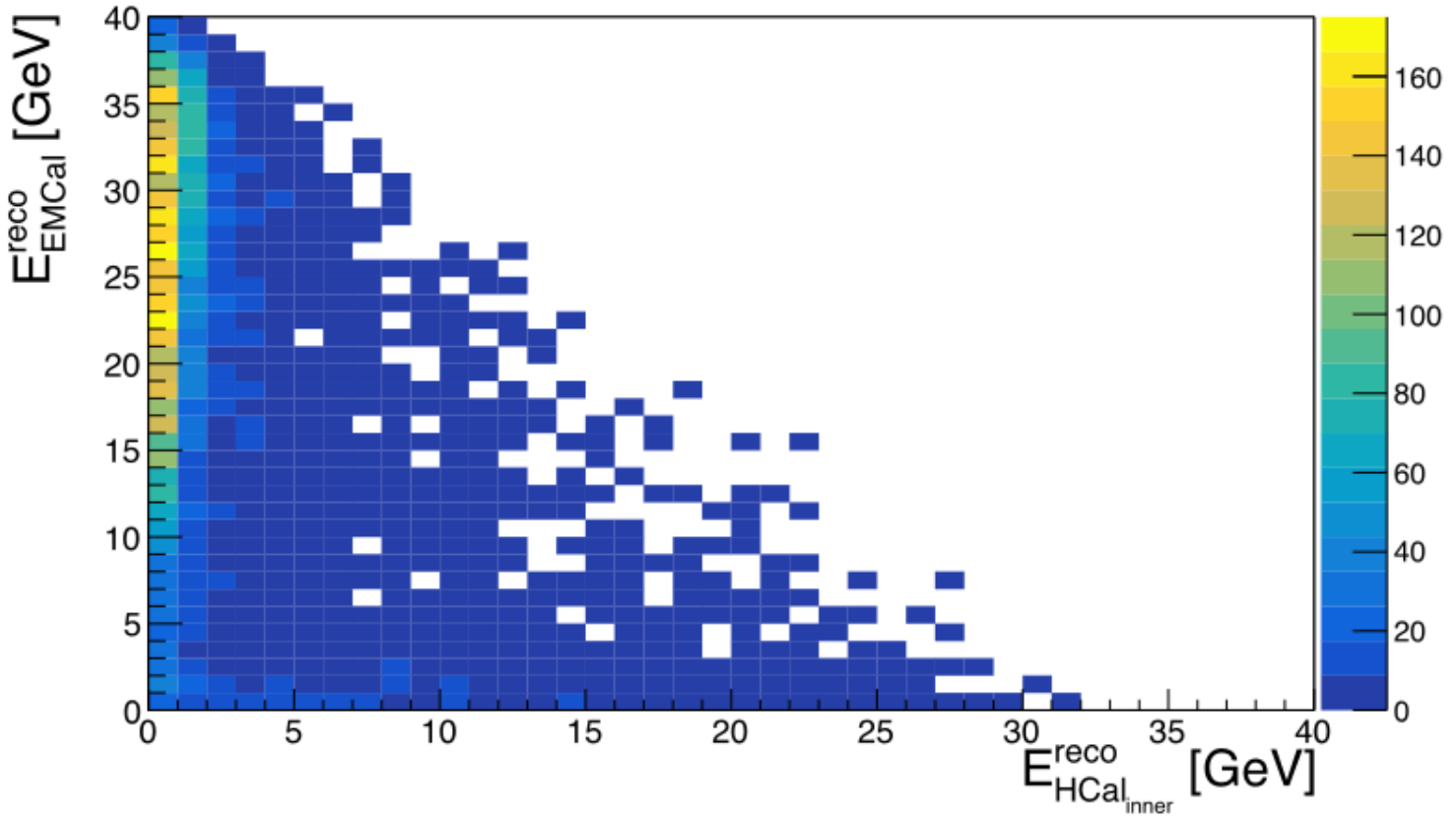


What is that feature…? Something from detector?

Must be somehow related to line feature from page 4?

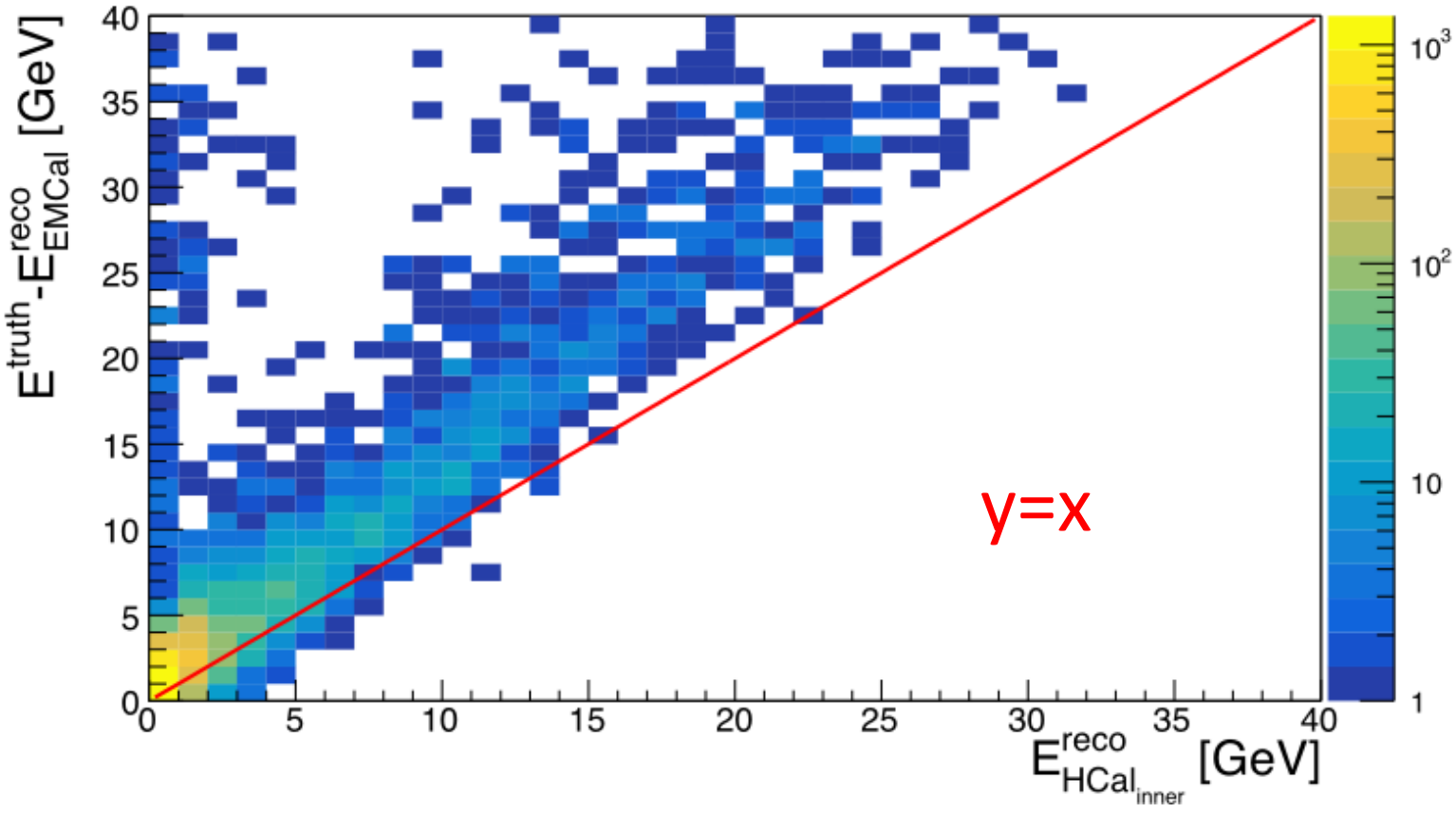
Cluster Energy Correlation

- Seems that the tunneling could be the cause of this
- Lower energy EMCal clusters match with high energy HCal clusters



Cluster Energy Correlation

- To check this, look at energy difference in EMCal vs. reconstruced HCal energy
- Clear correlation
- Energy missed in EMCal is being reconstructed as a cluster in the HCal

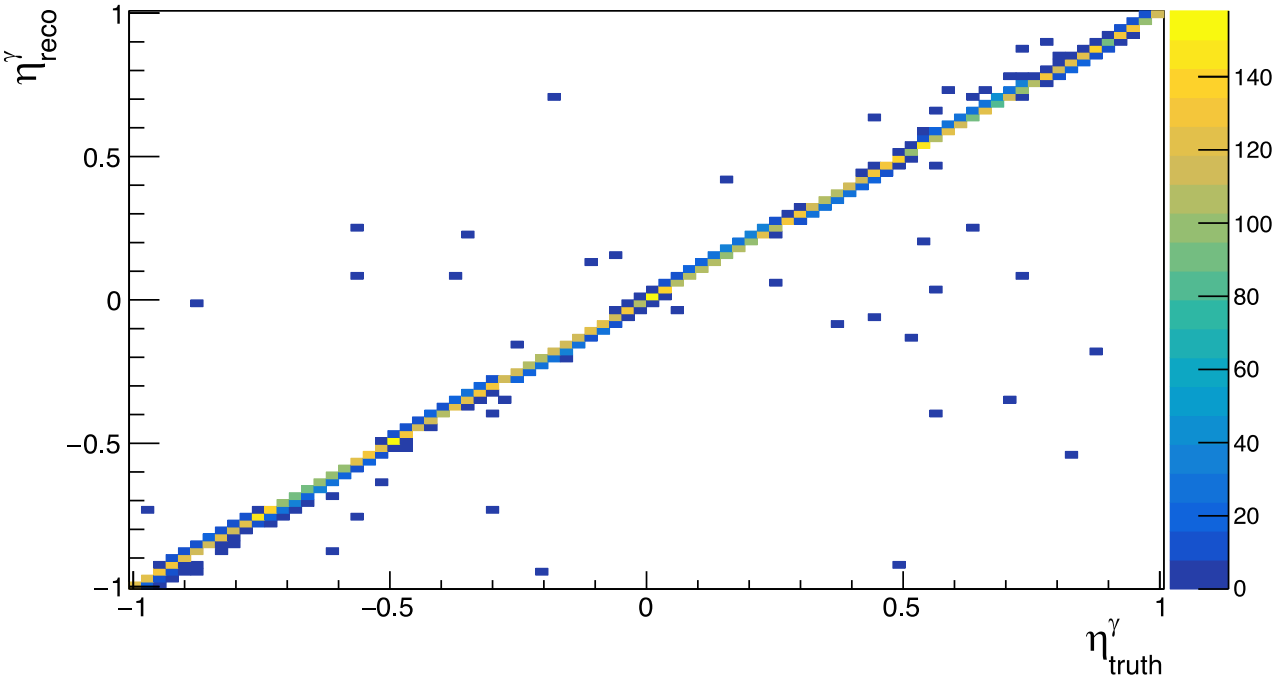


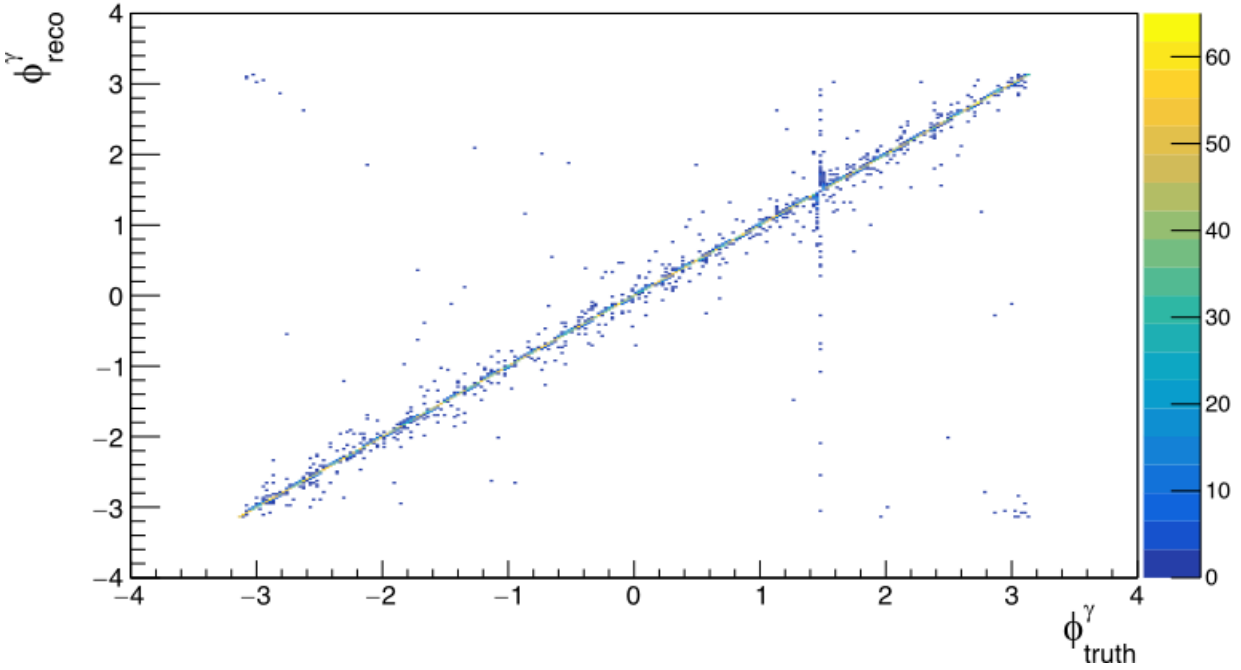
Conclusions

- Switched to 2D spacal reconstruction – will use this from now on
- Studies of nonlinearity and resolution of EMCal in simulation
- Seems that the low energy EMCal clusters are being reconstructed as high energy HCal clusters
- Clear nonlinearity in η,ϕ for the EMCal reconstruction

Back Up

Truth-Reco Angular Correlations





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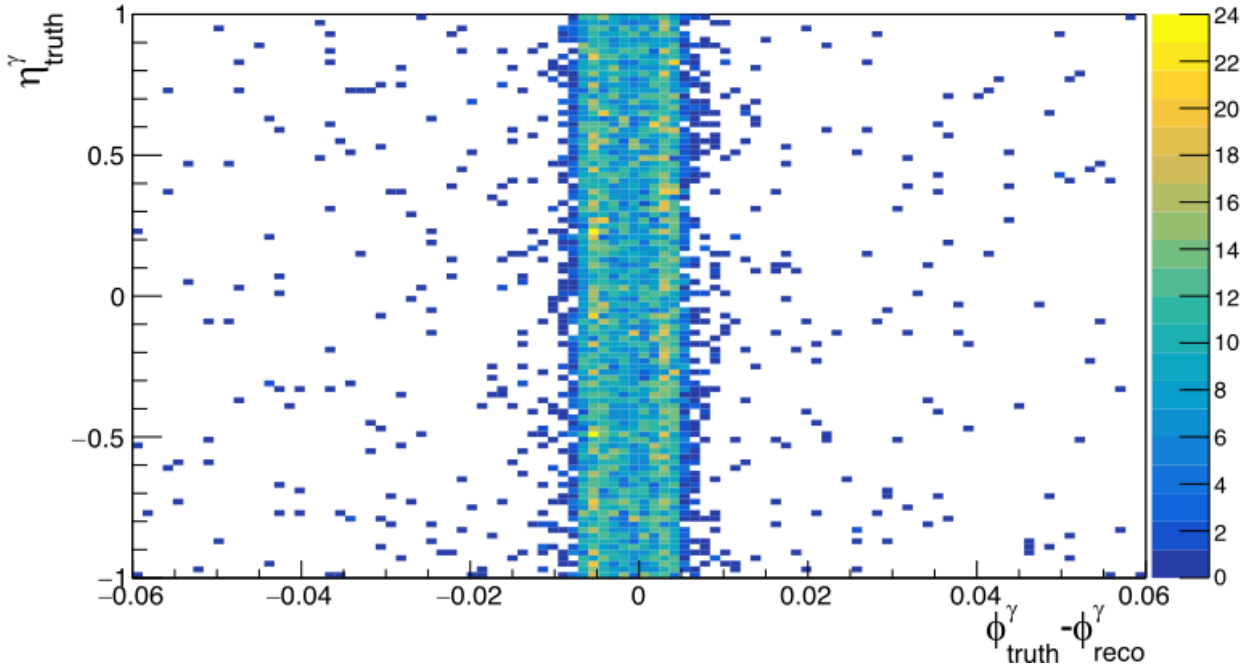

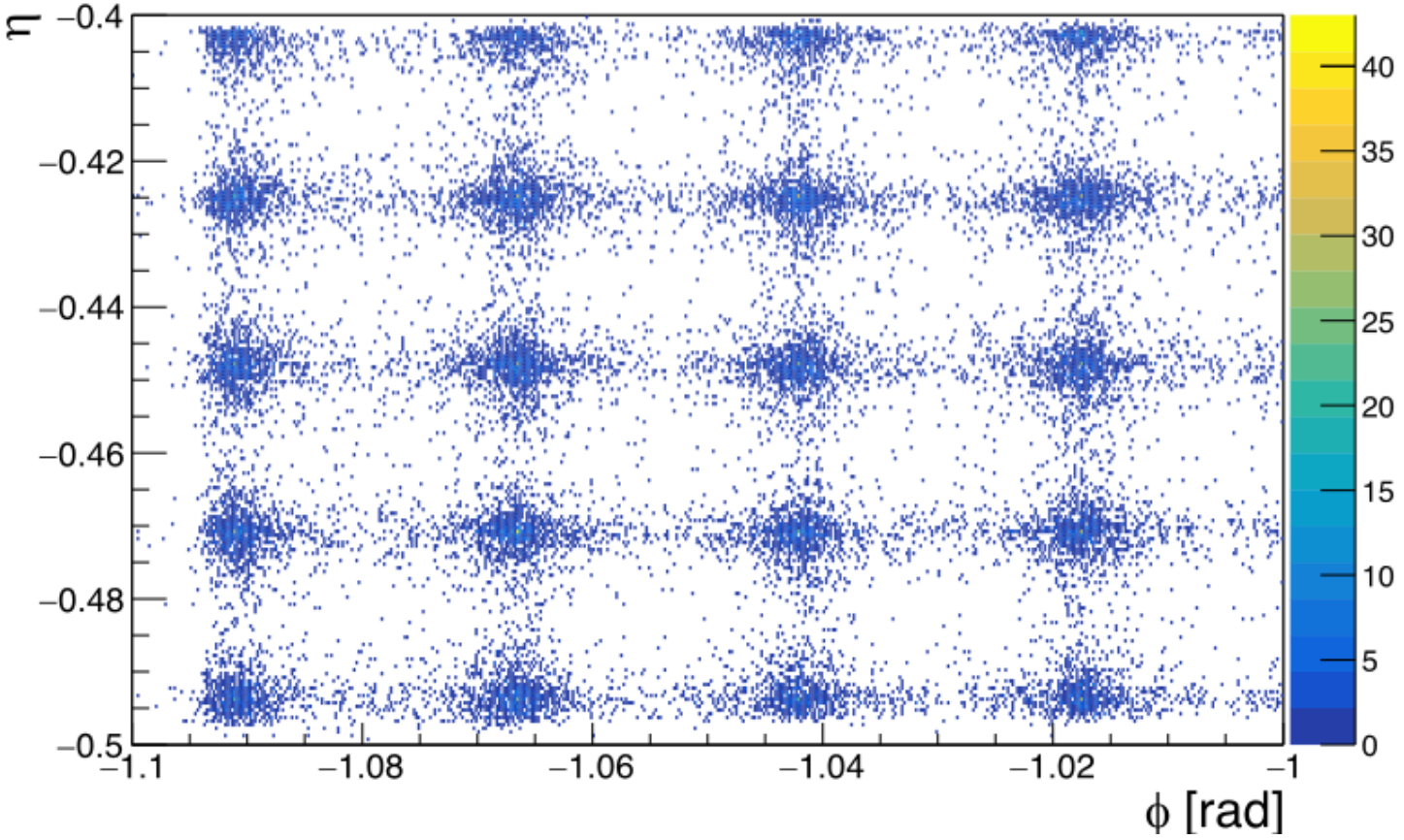

- I don’t see the same clustering behavior that Justin/Abinash see, but this is probably because I don’t have the necessary statistics in this set of simulations
- Requires very fine binning in eta and phi, in (basically) one tower